

CLAIMS

1. A method of depositing a dry, un-hydrated contact lens from a carrying head into a receptacle in mass-production, the method comprising pre-dosing said receptacle with a
5 spot of fluid, so that when the lens is brought into contact with the fluid the contact of fluid between lens and receptacle captures the lens consistently in the base of the receptacle.
2. A method as claimed in claim 1, wherein said spot of fluid is sufficient to capture the
10 lenses but less than the quantity required to hydrate the lens.
3. A method as claimed in claim 2, wherein the volume of fluid in said spot is less than
0.07 ml.
- 15 4. A method as claimed in claim 3, wherein the fluid in said spot is pure water.
5. A method as claimed in any preceding claim, further including adding further fluid after depositing the lenses in order to hydrate the lens.
- 20 6. A method as claimed in claim 5, further comprising a washing step wherein fluid surrounding the lens in the receptacle is replaced one or more times after hydration is complete.
7. A method as claimed in any preceding claim, further comprising adding a packing
25 fluid for the lens, while it remains in said receptacle, and prior to adding said closure.
8. A method as claimed in claim 7, wherein the packing fluid has a different composition to the hydrating fluid.
- 30 9. A method as claimed in claim 8, wherein the packing fluid has added components for safety and comfort.

10. A method as claimed in any preceding claim, wherein said receptacle in particular constitutes part of a package, such as a blister pack, the method further comprising adding a closure to the receptacle at a time after depositing the lens, to form a sealed lens package.

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11. A method as claimed in claim 10, wherein the closure comprises a foil heat-sealed to the receptacle.

10 12. A method as claimed in any preceding claim, wherein the receptacle is one of a plurality of receptacles, all being pre-dosed with fluid and loaded with lenses simultaneously.

13. A method of removing a dry, un-hydrated flexible contact lens from a mould comprising:

15 - providing a lens mould piece, having a concave optical surface and a convex backside surrounded by a flange, said mould being suitably flexible to allow said mould piece portion to deform upon the application of an externally applied force;

20 - forming and curing a dry contact lens onto the concave optical surface of said mould piece;

 - while holding the mould lens-uppermost, applying a downward force to the flange portion of the first piece, applying an upward force to the convex backside to deform said mould piece, said deformation substantially breaking adhesion between the dry contact lens and the concave optical surface of the mould piece;

25 and

 - while said forces are applied, capturing and removing the lens from said first optical surface by a lifting probe.

30 14. A method as claimed in claim 13, wherein the lifting probe comprises a suction probe having a soft tip so as not to damage the lens.

15. A method as claimed in claim 13 or 14, wherein the downward and upward forces are applied by respective parts of apparatus, arranged to move relative to one another, the apparatus further comprising means to support the mould piece at a defined position between said parts.

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16. A method as claimed in any of claims 13 to 15, wherein the step of forming and curing a dry contact lens comprises spin casting the lens in the concave optical surface of said mould piece.

10 17. A method as claimed in any of claims 13 to 15, wherein the step of forming and curing a dry contact lens comprises cast moulding said lens, wherein the contact lens is formed and cured between the concave mould piece and a convex mould piece having a second optical surface, the portions being separated after curing to leave a dry contact lens adhering to the concave optical surface of the first portion.

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18. A method as claimed in any of claims 13 to 17, wherein, after the lens has been formed and cured and before the mould pieces have been separated, the method further includes the step of applying a radial "breaking" force to the outer surface of said first mould piece, said breaking force deforming the first mould piece in the region of the junction between said first and second mould pieces, said deformation relative to the rigidity of the hard material which forms a lens and a flash ring causing said hard material to break adhesion with one of said surfaces.

19. A method as claimed in claim 18, wherein powered actuators move opposing jaws to apply the breaking force, and move plungers up from below while the flange is held stationary, to apply the downward and upward forces, the soft-tipped suction probe descending to an appropriate depth into the mould piece to retrieve the lens.

20. A method as claimed in any of claims 13 to 19, wherein the downward force is applied by a ring, held against the flange, the ring being formed by a solid surface or multiple lobes applied at intervals around said flange, the suction probe accessing the lens thorough the centre of the ring.

21. A method as claimed in claims 13 or 20, wherein the lens mould piece and force-applying parts are provided as an array of identical parts, processed simultaneously.
- 5 22. A method as claimed in any of claims 13 to 21, wherein the step of removing the lens from the first optical surface includes removing the lens through a flash ring of excess lens material attached to said mould piece
- 10 23. A method as claimed in any of claims 13 to 22, further comprising depositing the lens from said suction probe into a pre-dosed receptacle, as claimed in claims 1 to 12.
- 15 24. A method of processing a contact lens in a packaging receptacle, comprising:
 - providing a packaging receptacle comprising a concave cavity;
 - transferring into said receptacle an unhydrated contact lens;
 - providing a finishing head comprising adjacent inlet and outlet nozzles, said inlet nozzle tapered so that a focussed stream of fluid can be directed onto and behind the contact lens from a point off the axis of the cavity, said outlet nozzle located such that at a time after the inlet fluid has been added to the receptacle the fluid can be extracted from a point on or near the axis of the cavity;
- 20 25. A method as claimed in claim 24, further comprising the steps of:
 - hydrating said lens in the concave cavity of the receptacle with a hydrating fluid, and at a time after said lens has been hydrated, extracting said hydrating fluid;
 - washing the hydrated lens in said concave cavity with a flushing fluid applied by said inlet nozzle, and at a time after said lens has been washed, extracting said flushing fluid by said outlet nozzle.
- 25 26. A method as claimed in claim 24, further comprising the steps of:
 - repeating the washing step a sufficient number of times to suitably diminish the level of contaminants;
 - filling the majority of the volume of said receptacle with a packing fluid; and
 - hermetically sealing a closure to said receptacle to form a packaged, sealed and hydrated contact lens.

26. A method as claimed in claim 25, wherein the same nozzles are used for the hydration fluid and the packing fluid.
27. A method as claimed in claim 25, wherein different nozzles are used for the hydration fluid and the packing fluid.
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28. A method as claimed in claim 27, wherein the hydration step is initiated at a separate workstation using a different nozzle.
- 10 29. A method as claimed in any of claims 25 to 28, further comprising performing a brief drying step to the flange prior to said sealing step.
30. A method as claimed in any of claims 25 to 29, wherein a step of sterilisation is performed after said step of sealing the receptacle has been performed.
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31. A method as claimed in any of claims 24 to 30, wherein the step(s) of adding fluids to the concave cavity of the receptacle are performed by injection of said fluids into said cavity without wetting any part of said cavity rim.
- 20 32. A method as claimed in any of claims 24 to 31, wherein the timing of input of fluid to the cavity and its subsequent extraction is selected to ensure that the fluid has circulated the cavity sufficiently to provide uniform contact with the lens.
33. A method as claimed in any of claims 24 to 32, wherein the tapered inlet nozzle is
 - 25directed to cause rotation of the fluid about the cavity.
34. A method as claimed in any of claims 24 to 33, wherein the distance between the outlet nozzle and the cavity are also synchronised to the timing of the extraction of fluid from the cavity, such that the distance between the end of the outlet nozzle and the
 - 30surface of the fluid being extracted is substantially maintained at a set distance, while the fluid is being extracted.

35. A method as claimed in any of claims 24 to 34, wherein the outlet nozzle is also provided with a relief vent to prevent damage should the nozzle contact the lens.

36. A blister-type package containing at least one hydrated contact lens in a concave cavity, the package having at least one of characteristics A and B, and at least one of characteristics C, D and E, among the following:

- H) the radius of curvature of the internal surface of the cavity is greater than 10.0 mm, or greater than 11.0 mm;
- I) the ratio of the internal radius of the packed cavity to the lens back optical zone radius (BOZR) is greater than 1.1, preferably greater than 1.2 or even greater than 1.3;
- J) the maximum internal height of the cavity is less than 6 mm, preferably less than 5.6 mm;
- K) the vertical clearance between the lens sagittal height and the internal height of the cavity is less than 2.0 mm, or preferably less than 1.9 mm, 1.8 mm, or even 1.7 mm;
- L) the ratio of cavity sagittal height to lens sagittal height is less than 1.5;

37. A package as claimed in claim 36, also having at least one of the characteristics F and G among the following:

- M) the diameter of the cavity opening is less than 18 mm and preferably less than 17.5 mm; and
- N) the ratio of cavity opening to lens diameter is less than 1.3 and preferably less than 1.25.

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38. A package having all the characteristics of claims 36 and 37.

39. A package as claimed in any of claims 36 to 38, wherein the empty mass of the package excluding foil, fluid and lens is less than 1.0g per lens cavity.

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40. A package as claimed in claim 39, wherein the empty mass of the package excluding foil, fluid and lens is less than 0.8g per lens cavity.

41. A package as claimed in claim 40, wherein the empty mass of the package excluding foil, fluid and lens is less than 0.7g per lens cavity.
- 5 42. A package as claimed in any of claims 36 to 41, comprising a plurality of cavities formed integrally in a single sheet.
43. A package as claimed in any of claims 36 to 41, comprising a plurality of individual rimmed cavities attached to a single sealing foil.
- 10 44. A package as claimed in any of claims 36 to 43, wherein the or each cavity is sealed with a foil, each cavity containing a lens and preservative fluid.
45. A package as claimed in claim 44, wherein the mass of the finished package per
- 15 lens (with foil but not including further external packaging) is less than 1.3g.
46. A package as claimed in claim 45, wherein the mass of the finished package per
- lens (with foil but not including further external packaging) is less than 1.2g.
- 20 47. A package as claimed in any of claims 43 to 46, wherein the volume of the cavity in its sealed condition is in the range 0.8 ml to 1.0 ml.
48. A package as claimed in any of claim 47, wherein the volume of the cavity in its sealed condition is in the range 0.85 ml to 0.87 ml.
- 25 49. A method of manufacturing a packaged flexible contact lens comprising the steps of:
- forming and curing a dry, un-hydrated flexible contact lens in a mould;
- removing said contact lens from said mould, following the steps as claimed in
- 30 claims 13 to 23;
- transferring the dry, un-hydrated contact lens from a carrying head to a packaging receptacle, following the steps as claimed in claims 1 to 12; and

- processing the contact lens in said receptacle, following the steps as claimed in claims 24 to 35,

thereby producing a packaged, sealed and hydrated contact lens.

5 50. A method as claimed in claim 24 or 49, wherein the transferral of the dry contact lens into said receptacle is performed by a pick-and-place manipulator having a soft-contact head.

10 51. A method as claimed in claim 50, wherein the soft-contact head comprise a nozzle which has a selectable suction force that when enabled draws to the head a contact lens located in close proximity, and ensures that the contact lens is held against the head until the suction force has been disabled.

15 52. A method of packaging lens or a plurality of lenses in which a package has at least one cavity loaded with a dry contact lens following a method according to any of claims 1 to 35, the lens is hydrated in the cavity, the hydration fluid is exchanged for preservative fluid, and a sealing foil is fixed to the rim of each cavity so as to contain the fluid and lens.

20 53. A mould, suitably flexible and adapted for use with the method of removing a dry, un-hydrated flexible contact lens from a mould as claimed in any of claims 13 to 23.

54. A mould as claimed in claim 53, comprising a relatively flexible cavity attached to a rigid frame.

25 55. Processing equipment specifically adapted for use in performance of the steps of the method of processing a dry contact lens in a packaging receptacle, as claimed in any of claims 1 to 35 or any of claims 49 to 52.

30 56. Contact lens production equipment, specifically adapted for use in the method of manufacturing as claimed in any of claims 1 to 35 to produce a packaged flexible contact lens as claimed in any of claims 44 to 48, or claim 52.

57. A package comprising a contact lens in fluid in a sealed container produced in accordance with the method as claimed in any of the claims 1 to 35, or claim 52.
- 5 58. A method of supplying contact lenses to a wearer when a multi-lens package as claimed in any of claims 44 to 48, or claim 52, or claim 57, is produced and dispatched by mail or courier services direct to the wearer.
- 10 59. A method of supplying contact lenses to a wearer as claimed in claim 58, performed on the instruction of an optician.
60. A method of supplying contact lenses to a wearer as claimed in claims 58 or 59, wherein supply is to a wearer within the territory of this patent from a country outside that territory.
- 15 61. A method as claimed in any of claims 1 to 35, or any of claims 49 to 52, or any of claims 58 to 60, wherein the or each contact lens is a 'daily-disposable' contact lens intended to be disposed of after being worn for no more than a single day.
- 20 62. A package as claimed in any of claims 36 to 48, or claim 57, wherein each contact lens is a 'daily-disposable' contact lens intended to be disposed of after being worn for no more than a single day.
- 25 63. A package as claimed in claim 62 containing at least fifteen lenses in one or more sheets.
64. A package as claimed in claim 63 containing at least thirty lenses in one or more sheets.